

The background of the slide features the official seal of Air University. It is a circular emblem with a blue outer ring containing the text "INTELLECTUAL AND LEADERSHIP CENTER OF THE AIR FORCE" in white capital letters. The center of the seal is a lighter blue circle with a white sword pointing upwards. Behind the sword are two golden wings spread out horizontally. The words "AIR UNIVERSITY" are written in white across the upper part of the central blue circle.

# **AY 11 Continuous Process Improvement for Strategic Leaders IP #7**

**Department of Leadership and Strategy**

***We Produce the Future***

**Col PJ McAneny  
AWC/DA**



# Plan for the Day



*Develop America's Airmen Today ... for Tomorrow*

- **1<sup>st</sup> Hour - Quick Admin / “The Goal” Movie Presentation**
- **2<sup>nd</sup> Hour - Theory of Constraints Overview**
- **3<sup>rd</sup> Hour - Continue Theory of Constraints Overview and Reading Review**

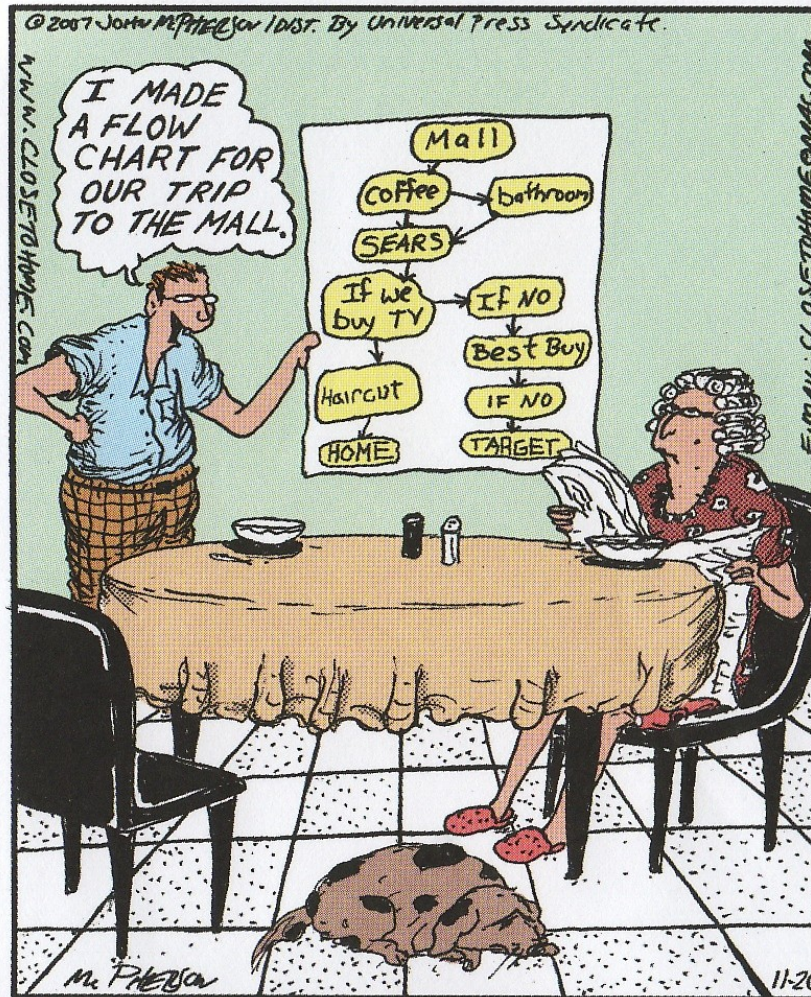




# Admin



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Though he had been retired for only three days, Marilyn was already growing tired of having Clyde around all day long.





# Admin



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- File Folders for Case Study Analysis Materials
  - M:\Electives and Research\Course Info\CPI for Strategic Leaders\Student Case Study Analysis
  - Please load materials by COB Monday (20 Sep) so other students (and faculty!) have a chance to access and print before class Tuesday morning.
- Personal Lean Moment
  - Parkinson's Law: *"Work expands so as to fill the time available for its completion."*



# Voice of the Customer



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- Seinfeld – Rental Car Reservations





# Movie Time



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- **Eliyahu Goldratt's: The Goal - The How-To Version**





# Theory of Constraints



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## Systems Thinking and The Theory of Constraints

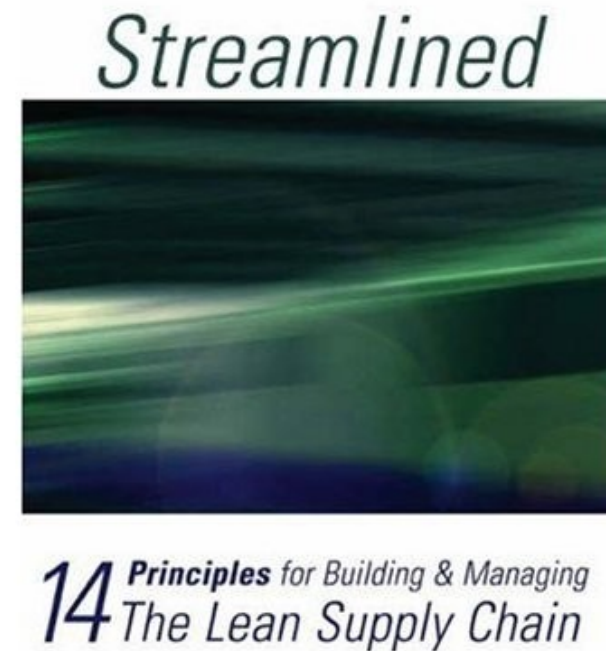
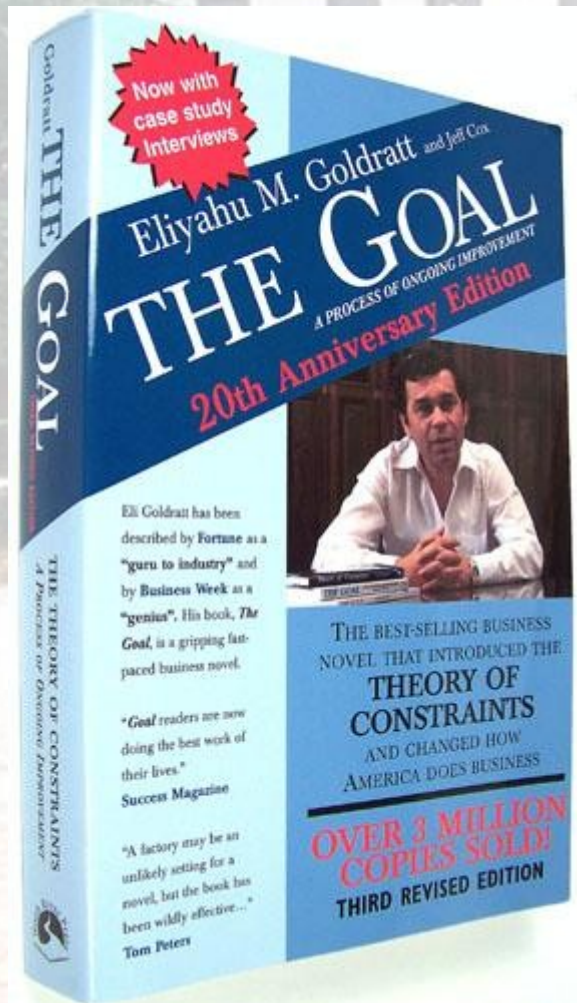


# Theory of Constraints



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## References







# Theory of Constraints



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## Systems Thinking

- Integrated decision making
- “Big Picture” Thinking
- Thinking “Globally” rather than “Locally”
- Understanding how localized decision making can affect the overall goal



# Theory of Constraints



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## The Theory of Constraints

- Eli Goldratt, a physicist.
  - Optimized Production Technology (OPT): a scheduling package.
  - *The Goal and the Theory of Constraints.*
- TOC provides a way of thinking globally.
- Goldratt challenges the conventional approach (the “cost world” perspective) to managing organizations.





# Theory of Constraints



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The Theory of Constraints is based on two premises:

1. The Goal of a business is to make more money, ... in the present and in the future.
2. A system's constraint(s) determine its output.



# The Tyranny of the Urgent



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- Everybody seemingly working hard; lots of overtime
- Using the wrong metrics
- Quality “flavor of the month program”
- Push Systems
- WIP everywhere
- Variation in process times





# Theory of Constraints



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## The Throughput World: The Five Step Focusing Process of TOC

- Step 1: IDENTIFY the System's Constraint(s)
- Step 2: Decide how to EXPLOIT the System's Constraint(s)
- Step 3: SUBORDINATE Everything Else to that Decision
- Step 4: ELEVATE the System's Constraint(s)
- Step 5: WARNING!!!! If in the previous steps a constraint has been broken, go back to Step 1 but do not allow INERTIA to create a system constraint



# Bottlenecks (or Constraints)

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Definition: any resource whose capacity is equal to or less than the demand placed on it

- To find bottlenecks...look for a huge pile of WIP sitting in front of it
- Strategic communication is important...so the whole organization understands what the bottleneck is
- Balance flow, not capacity. Make flow through the bottleneck slightly less than market demand.
- Don't waste bottleneck's time (idle time, processing defective parts, processing unneeded parts, etc.)
- Find ways to remove load from bottlenecks and give to non-bottlenecks
- Put QC before bottlenecks and treat parts already through the bottlenecks with extreme care to avoid rework





# Bottlenecks - continued



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- An hour lost at a bottleneck is an hour lost to the entire system
  - Conversely, an hour saved at a non-bottleneck is a mirage
  - Use bottlenecks to determine release of all materials into the plant
  - Bottlenecks should dictate both inventory and throughput
- **Improvement is not defined by reducing costs but by increasing throughput (see “*Growth Strategy*”)**



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## Lean Supply Chain Principle 12\*

*Focus on bottleneck resources because they control the flow. Synchronize flow by first scheduling the bottleneck resources on the most productive products; then schedule non-bottleneck resources to support the bottleneck resources.*





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## Lean Supply Chain Principle 13\*

*Do not focus on balancing capacities. Focus on synchronizing the flow.*

**\*Streamlined: 14 Principles for Building and Managing the Lean Supply Chain**



# Why Balanced Plants ~~Aren't?~~



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- Definition: **Capacity** of each and every resource is balanced exactly with **demand** from the market
  - But you have dependent events (an event or series of events which must take place before another can begin...the subsequent event depends on the one prior to it.) and statistical fluctuations (processes that vary from one instance to the next).
  - Covariance: in a linear dependency of two or more variables, the fluctuations of the variables down the line will fluctuate around the maximum deviation established by any previous variables
  - *Therefore...you need Lean to reduce variability.*





# Theory of Constraints



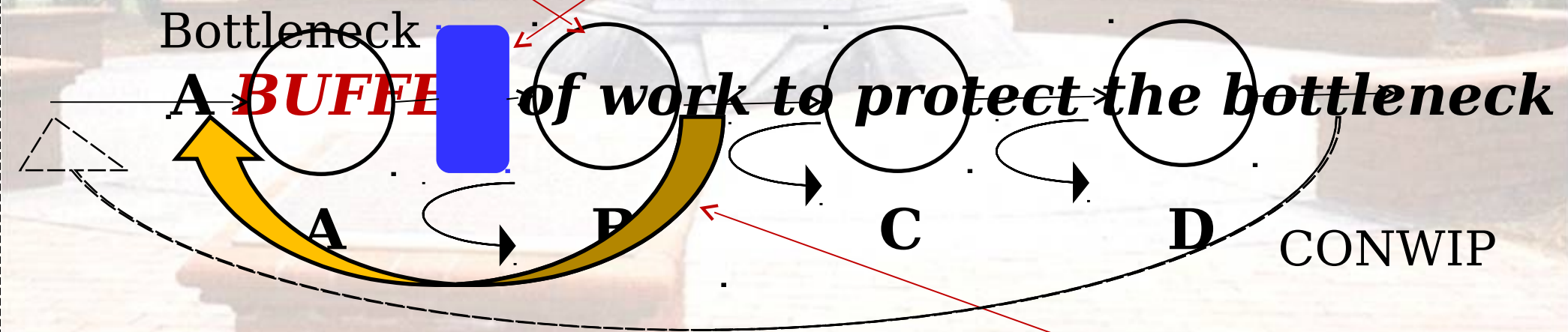
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## How do we manage the bottleneck operation better?

The Drum-Buffer-Rope Concept ...or “Pull from the Bottleneck.”

- The “Magic of Pull” = Limits WIP and therefore flow times reduced

**The Bottleneck beats the *DRUM***





# Theory of Constraints



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## Types of Constraints

1. Physical Constraints:
  - Physical, tangible; easy to recognize as constraint.
  - Machine capacity, material availability, space availability, etc.
2. Market Constraints:
  - Demand for company's products and services is less than capacity of organization, or not in desired proportion.
3. Policy Constraints:





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## Policy Constraints

1. Mindset Constraints
  - A constraint if thought process or culture of the organization blocks design & implementation of measures & methods required to achieve goals
2. Measures Constraints
  - A constraint if the measurement system drive behaviors that are incongruous with organizational goals
3. Methods Constraints
  - A constraint when procedures and techniques used result in actions incompatible with goals



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## Policy Constraints

### Mindset Constraints

- The decision to pursue **Option 1 (Layoffs)** stems from a mindset constraint – that the way to profitability is by reducing the operating expenses (OE).
- **Option 2 (Outsourcing)** is driven by a similar mindset.





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## Dell Layoff Operating Expense (or “Cost”) Strategy

- Cost of layoffs to save money:
  - early termination of 2,000 workers (x \$50K)  
= \$100M (expected savings)

2001 Revenue = \$30B (Therefore, \$100M is a drop in the bucket. Consider impact on morale, recruiting, etc.)

- Hidden Costs:
  - Severance Pay = \$10M
  - Training = \$75M for new hires in the future



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## Systems Thinking and The Theory of Constraints

### The “Throughput World” Perspective





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## Option 3 - Promoting a Growth Strategy

### Exploiting Synergies between Lean and TOC



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## TOC Performance Measures

Throughput (T): The rate at which the system generates money through sales. (i.e. “**Money Out**”)

Inventory (I): All the money the system invested in purchasing things which it intends to sell. (i.e. “**Money In**”)

Operating Expenses (OE): All the money the system spends in order to turn inventory into throughput. (i.e. “**Money Stuck Inside**”)

$$T = (\text{Sales Revenue} - \text{Variable Costs}) \text{ per unit}$$





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## Lean Supply Chain Principle 11\*

*Decisions should promote a growth strategy. While enterprises should attempt to simultaneously increase throughput (**T**), decrease inventory (**I**), and decrease operating expenses (**OE**), the focus must be on improving throughput.*

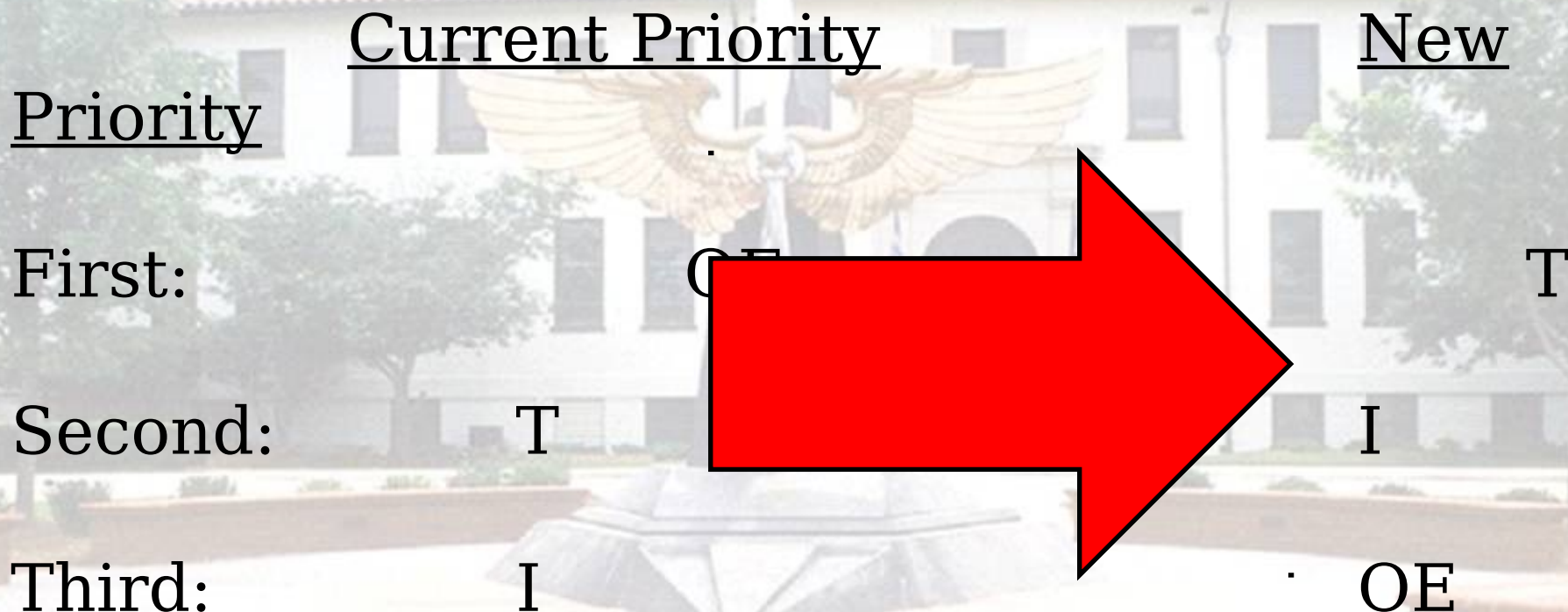


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## Shifting Paradigms







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## Lean Combines with TOC to Create:

A Growth Strategy: The *Viable Vision* -

- in which you grow the business by making the customer an offer that he/she can't refuse.
- in which you create the capacity to grow by the elimination of waste.



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## Lean Supply Chain Principle 14\*

*Reduce variation in the system. Reduced variation allows the supply chain to generate higher throughput (**T**) with lower inventories (**I**) and lower operating expense (**OE**).*

**\*Streamlined: 14 Principles for Building and Managing the Lean Supply Chain**





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## Comparison of the Cost Cutting and Throughput Growth Perspectives

- Lean reduces labor requirements, flow time, floor space and creates additional capacity.
- In the cost cutting perspective, we are only able to harvest the improvements that relate to variable cost, in this case direct labor.
- In the throughput growth perspective, when we are able to grow the market without adding capital costs,



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## Is this type of improvement achievable?

Real World Example - (Commercial Airline PDM):

- America Airlines in Tulsa reduced its PDM flow times from 23 days to 12 days.
- With the 12 day flow time for a 5000 standard hours package the burn rate is 417 hours per plane per day. (World class organizations exceed this burn rate significantly.)
  - A commercial aircraft is worth about \$500M. Having it out of service for 11 fewer





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## How to increase productivity and reduce variability....

These gains can be achieved by point of use materials, point of use tooling, standard work, better information (to allow the mechanics to spend 67% more time turning wrenches rather than hunting and gathering).



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## Changes required to achieve Option 3 (The Growth Strategy):

- Choreographed work requirements (what will be done each day, but may vary between aircraft)
- Right parts/tools at right place at right time
- Flex capacity/cross training for handling variation
- Information system in the field and up-front inspection for anticipating “over and above” work
- Execution system for prioritizing work, particularly in the back shops





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## Changes required to achieve Option 3 (The Growth Strategy):

- Measurement systems to support throughput, rather than local efficiencies.
- Focus on managing bottlenecks:
  - maximize throughput at the bottleneck
  - control rate of release of work into the system to match the pace of the bottleneck to avoid buildup of WIP
- Do as much work as possible in the cells to reduce handoffs between the hanger and the back shops and between the hanger and external suppliers.



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## Lean Supply Chain Principle 1\*

*Improving the performance of every subsystem may not improve system performance. Improvements in subsystem performance must be gauged only through their impact on the whole system.*

**\*Streamlined: 14 Principles for Building and Managing the Lean Supply Chain**

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Fly - Fight - Win





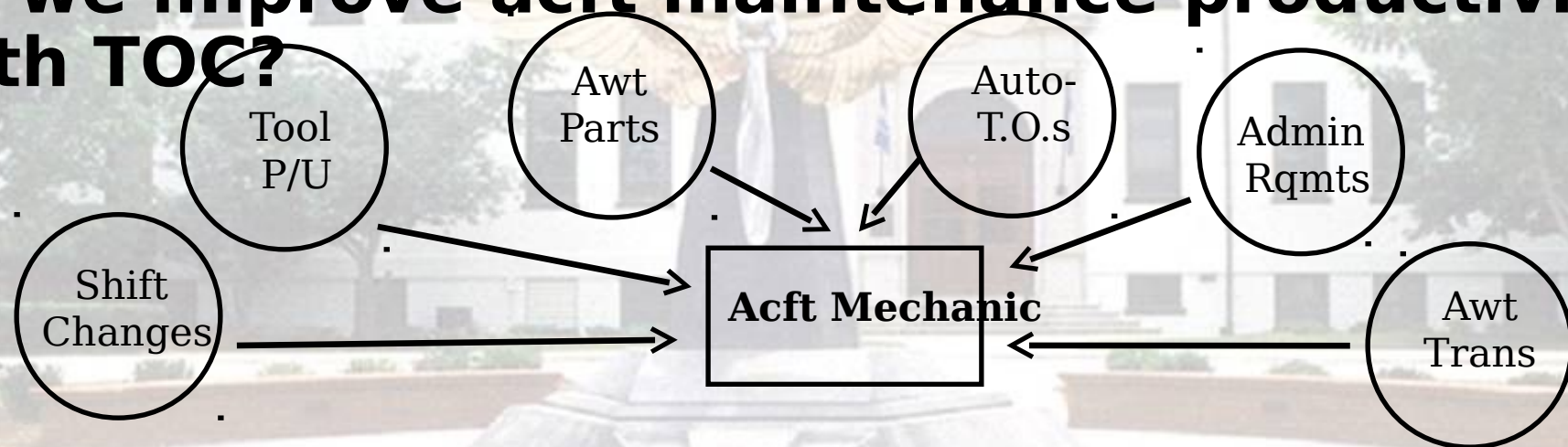
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## • Thinking about Aircraft Maintenance...

Can we improve acft maintenance productivity with TOC?



- But acft maintenance is not considered a linear flow process. Can it be?
- Maybe just applying Lean to the enabling sub-processes is a better way to start. (i.e. Create capacity by eliminating waste)
- Then apply the following to induce linear flow with Pull: "Don't [generate] anything until it's really needed, and then make it very quickly." from Womack and Jones, *Lean Thinking*, p. 71



# TOC Key Takeaways



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- The Five Step Focusing Process of TOC is never ending...always search for the new constraint.
- Policy Constraints are the most difficult to identify and often the most damaging to productivity.
- “Growth” Strategies are ultimately more effective than “Cost” Strategies.
- Srinivasen’s Lean Supply Chain Principle #1:  
*Improving the performance of every subsystem may not improve system performance. Improvements in subsystem performance must be gauged only through their impact on the whole system.*





# NEXT CLASS



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## ***IP#8*** ***Student Case Study*** ***Analysis***

# ***The Intellectual and Leadership Center of the Air Force***

***We Produce the Future...***

***One Student at a Time***

***One Faculty Member at a Time***

***One Idea at a Time***

